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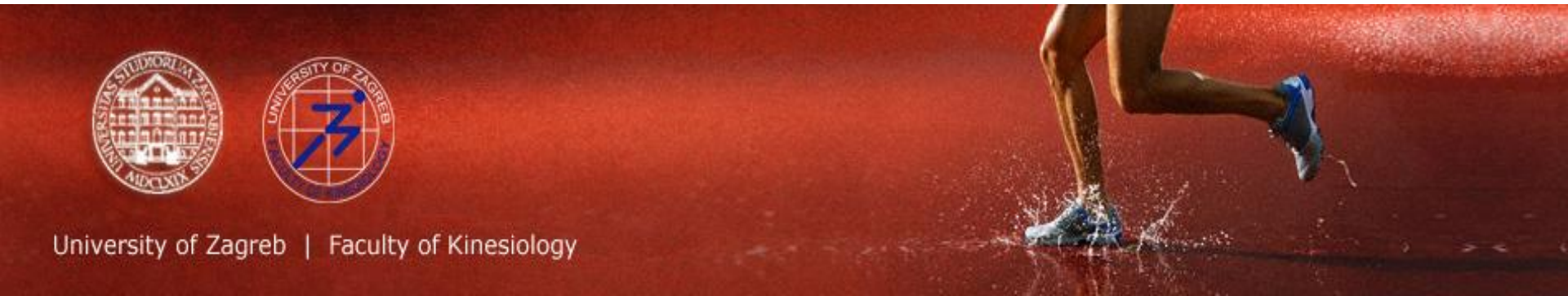
Obvladajmo stres za zdrava delovna mesta!

Impact of physical activity on stress. Can we reduce stress through exercise?

Maroje Sorić, MD, PhD

Department of Sport and Exercise Medicine,
Faculty of Kinesiology, Zagreb, Croatia



Outline

- Understanding physical activity and stress
- Are PA and stress associated?
- Do PA and exercise improve one's ability to adapt to stress?
- Can exercise programs reduce stress?
- Can exercise programs reduce stress-induced medical problems?
- Employers corner
- Implementation at worksite – the optimal dose?

Understanding Physical activity - Definitions of key terms

PHYSICAL ACTIVITY **(PA)** - any bodily movement produced by skeletal muscles that results in energy expenditure above resting levels

EXERCISE – PA that is planned, structured, and repetitive and has as an objective the improvement or maintenance of physical fitness

PHYSICAL FITNESS- The ability to carry out daily tasks with vigour and alertness, without undue fatigue and with ample energy to enjoy [leisure] pursuits and to meet unforeseen emergencies.

Includes cardiorespiratory fitness, muscular strength and endurance, body composition and flexibility, balance, agility, reaction time and power

The construct of PA

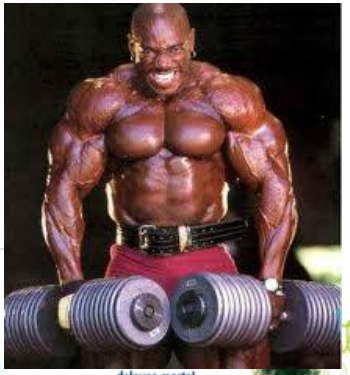
- Operationalized through FITT principle:
  - Frequency
  - Intensity
  - Time
  - Type

Understanding PA - Types of exercise

- Aerobic (endurance, cardiorespiratory)
  Increases cardiorespiratory endurance

- Anaerobic
  short-lasting, high-intensity activity, promotes speed, strength and power

- Resistance
  Increases muscle mass, muscle endurance, strength and power



Understanding PA - Epidemiology

- around 60 % of the world does not engage in the recommended volume of PA*
- causes 3 200 000 deaths/year worldwide* (ranked 4.)
  - 1 000 000 deaths in Europe (10%; ranked 3.)

*WHO. Global Health Risks, 2009

Understanding stress

'Stress is a word used to describe experiences that are challenging emotionally and physiologically' [1]

Induces (patho)physiological changes:

- ↑ Stress hormones (adrenaline, cortisol)
- ↑ Heart rate
- ↑ Blood pressure

↓

Medical problems and illnesses

1 McEwen BS. Physiology and neurobiology of stress and adaptation: central role of the brain. Physiol Rev. 2007;87(3): 873–904.

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Are PA and stress associated?

Associations of PA and stress

Stress and life dissatisfaction are inversely associated with jogging and other types of physical activity in leisure time—The Copenhagen City Heart Study

Scand J Med Sci Sports 2005: 15: 107–112

P. Schnohr[1], T. S. Kristensen[2], E. Prescott[1,3], H. Scharling[1]

- >12000 participants
  4-yr follow-up
- Leisure time PA
  Up to **70%** lower risk
  for high stress
- Change in PA
  70% lower risk
  for high stress in constantly active participants

Physical activity level	High level of stress
	Mult. adj.[c] OR (95% CI)
Low	1
Moderate	0.46 (0.39–0.54)
High	0.42 (0.35–0.51)
Joggers	0.30 (0.16–0.56)

Physical activity level (1976–1978)	Physical activity level (1981–1983)	High level of stress
		Mult. adj.[c] OR (95% CI)
Sedentary	Sedentary	1
	Active	0.48 (0.36–0.63)
Active	Sedentary	0.64 (0.49–0.83)
	Active	0.29 (0.23–0.36)

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Associations of PA and stress

A prospective study of leisure-time physical activity and mental health in Swedish health care workers and social insurance officers

Ingibjörg H. Jonsdottir [a,b,*], Lars Rödjer [c], Emina Hadzibajramovic [a], Mats Börjesson [c], Gunnar Ahlborg Jr. [a,c]

Preventive Medicine 51 (2010) 373–377

- 3114 health care workers in Sweden
- 2-y follow-up

60% lower risk of high stress level in active participants

	Number included in the analysis (n)	Unadjusted RR (95% CI)	Adjusted RR (95% CI)
High stress level[a]	2483		
– Sedentary		1	1
– LPA		0.52 (0.37–0.72)	0.51 (0.37–0.72)
– MVPA		0.40 (0.28–0.58)	0.40 (0.27–0.59)
High burnout[b]	2050		
– Sedentary		1	1
– LPA		0.58 (0.40–0.83)	0.59 (0.41–0.85)
– MVPA		0.40 (0.27–0.61)	0.43 (0.28–0.64)
HAD depression[c]	2818		
– Sedentary		1	1
– LPA		0.36 (0.21–0.61)	0.37 (0.21–0.63)
– MVPA		0.27 (0.14–0.51)	0.29 (0.15–0.57)
HAD anxiety[c]	2553		
– Sedentary		1	1
– LPA		0.66 (0.42–1.03)	0.65 (0.42–1.02)
– MVPA		0.58 (0.35–0.94)	0.56 (0.34–0.94)

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Causality?
Bidirectional relations?

Stress and PA

Perceived stress as a risk factor for changes in health behaviour and cardiac risk profile: a longitudinal study

N. H. Rod[1], M. Grønbæk[2], P. Schnohr[3], E. Prescott[4] & T. S. Kristensen[5]

J Intern Med 2009; **266:** 467–475.

- 7500 participants, Denmark
- 16-y follow-up

	Study population	Low stress		Medium stress		High stress	
	N	%	OR[a] (95% CI)	%	OR[a] (95% CI)	%	OR[a] (95% CI)
Physical inactivity							
Baseline	11,960	15	1 (ref)	16	1.19 (1.07; 1.32)	32	2.63 (2.25; 3.08)
Become inactive[b]	6058	11	1 (ref)	9	0.97 (0.81; 1.16)	19	1.90 (1.41; 2.55)
Become active[c]	929	69	1 (ref)	67	0.84 (0.62; 1.14)	63	0.74 (0.48; 1.14)

twofold risk of becoming inactive in the high stress group

Do PA and exercise improve one's ability to adapt to stress?

The effect of PA level on physiological reactions to stress

- 50 young women
- Inactive vs. Moderately active vs. Highly active
- Reaction to acute stress

Psychology of Sport and Exercise 14 (2013) 266–274

Psychoneuroendocrinology (2009) 34, 190–198

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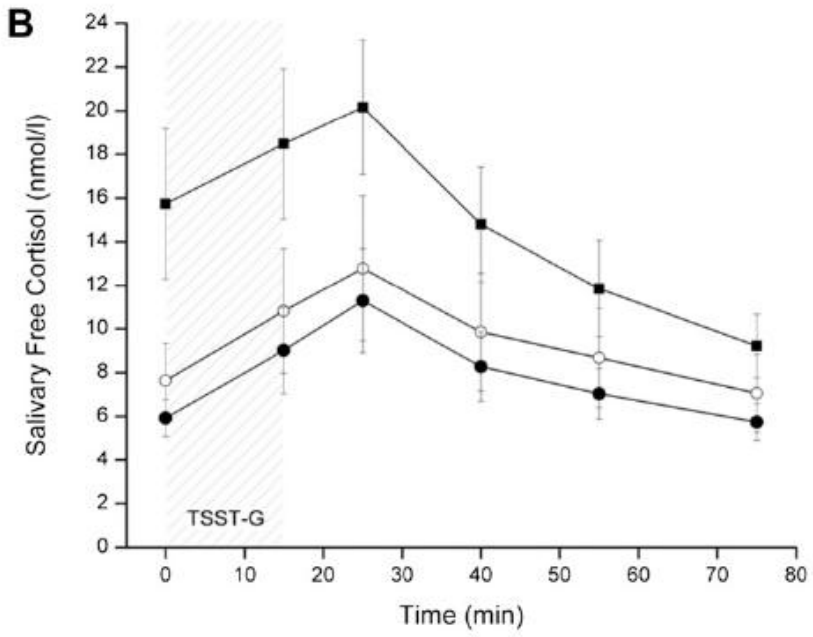
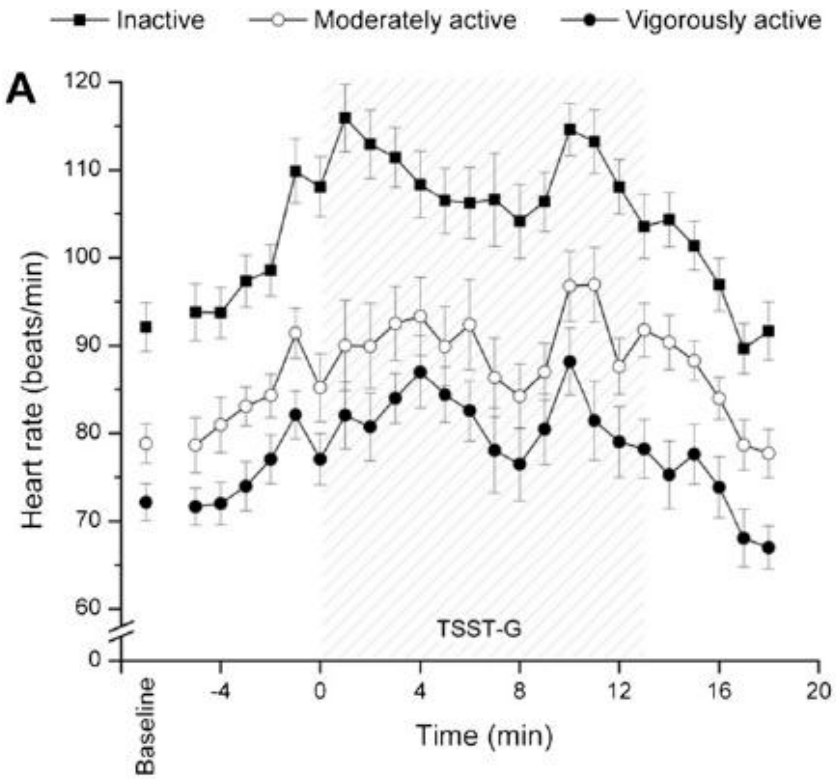
The effect of PA level on physiological reactions to stress

Stress hormone (cortisol)



Psychology of Sport and Exercise 14 (2013) 266–274

Heart rate



Psychoneuroendocrinology (2009) 34, 190–198

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The effect of PA level on physiological reactions to stress

Stress related blood pressure – effect of acute exercise

The effect of acute aerobic exercise on stress related blood pressure responses: A systematic review and meta-analysis

Mark Hamer [a,*], Adrian Taylor [b], Andrew Steptoe [a]

Biol Psychol. 2006 Feb;71(2):183-90

Table 2
Summary of meta-analysis to examine the effect of acute exercise on stress related blood pressure responses

Effect	No. of studies	Total no. of subjects	Combined ES	Combined *z*	Combined *p*	Fail-safe *N*	Critical no. for drawer	Absolute effect ± S.D. (mmHg)
SBPR	15	496	0.38	4.03	<0.01	1340	85	−3.7 ± 3.9
DBPR	15	496	0.40	4.86	<0.01	1949	85	−3.0 ± 2.7

Note: Absolute effect is the calculated difference in change score from pre- to post-stressor between exercise and control conditions.

- Exercise reduces both SBP and DBP
  - Larger effects for larger doses
  - Min dose: 30 min at 50% max

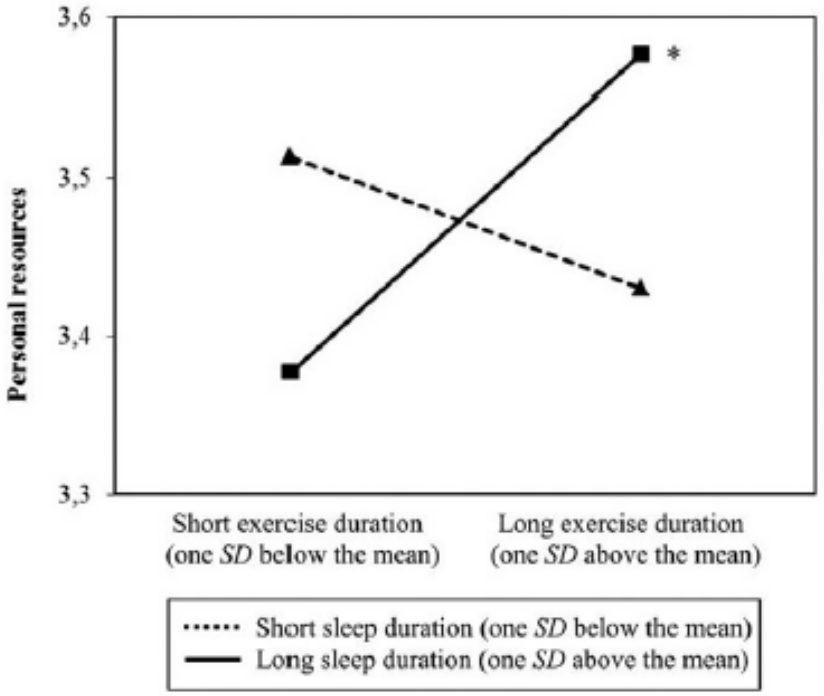
Exercise and resilience

- 144 employees

Personal resources (resilience, optimism)

- The effect of exercise is positive only when sleep is prolonged

APPLIED PSYCHOLOGY: HEALTH AND WELL-BEING, 2013, 5 (3), 348–368
doi:10.1111/aphw.12014



Can exercise programs reduce stress?

The effect of exercise training on stress

Differential Effects of Acute and Regular Physical Exercise on Cognition and Affect

Michael E. Hopkins, F. Caroline Davis†, Michelle R. VanTieghem, Paul J. Whalen, and David J. Bucci

Neuroscience. 2012 July 26; 215: 59–68.

- 75 young adults; 4 week exercise programme
  - 30 min of aerobic exercise
  - +/- exercise on test day

positive mood ↑

anxiety ↓

perceived stress →

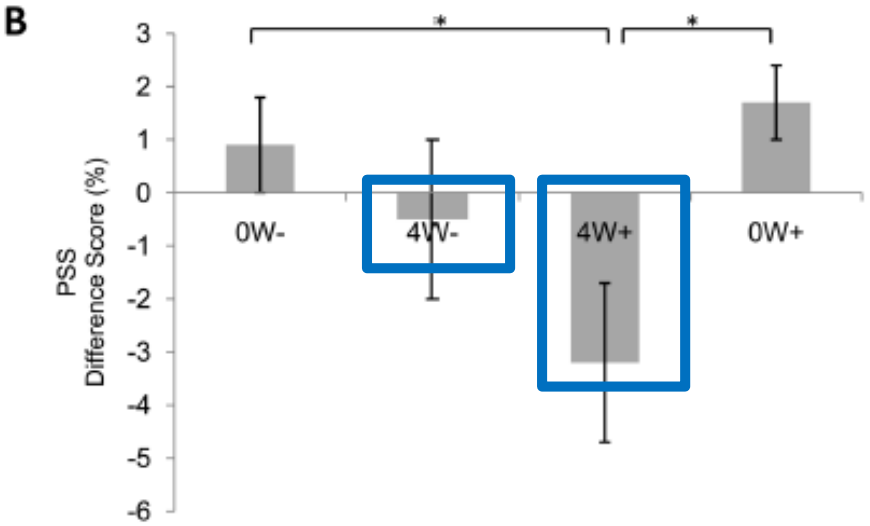


Figure 4.
A) Perceived stress (PSS) during Visits 1 and 2, and **B)** difference scores between visits. Group 2 exhibited a significant decrease in stress from Visit 1 to Visit 2. Data are mean ± SEM.

The effect of exercise training on stress

An effective exercise-based intervention for improving mental health and quality of life measures: a randomized controlled trial

Evan Atlantis, B.Sc.,[a,*] Chin-Moi Chow, M.Sc., Ph.D.,[a]
Adrienne Kirby, M.Sc.,[b] and Maria Fiatarone Singh, M.D., F.R.A.C.P.[a]

Preventive Medicine 39 (2004) 424–434

- 75 participants;casino employees
- 20 min exercise; 3x/week; 6 months

Outcome measure	Treatment		Controls		*t* test (week 0)	Adjusted baseline[a] (week 24)	Adjusted covariates[b] (week 24)	Effect size[d]
SF-36[c]	Mean	(SD)	Mean	(SD)	*P*	*P*	*P*	
Depression								
Pre	7.4	(9.6)	6.0	(7.7)	0.58	0.085	0.048	−0.16
Post	3.0	(2.9)	4.1	(4.1)				
%Δ	−59		−31					
Anxiety								
Pre	3.6	(4.8)	5.3	(6.5)	0.35	0.23	0.23	0.05
Post	1.7	(1.8)	3.2	(4.4)				
%Δ	−53		−40					
Stress								
Pre	10.6	(8.8)	9.5	(8.0)	0.67	0.012	0.036	−0.56
Post	4.0	(3.4)	7.1	(7.5)				
%Δ	−62		−25					

Can exercise programs reduce stress-induced medical problems?

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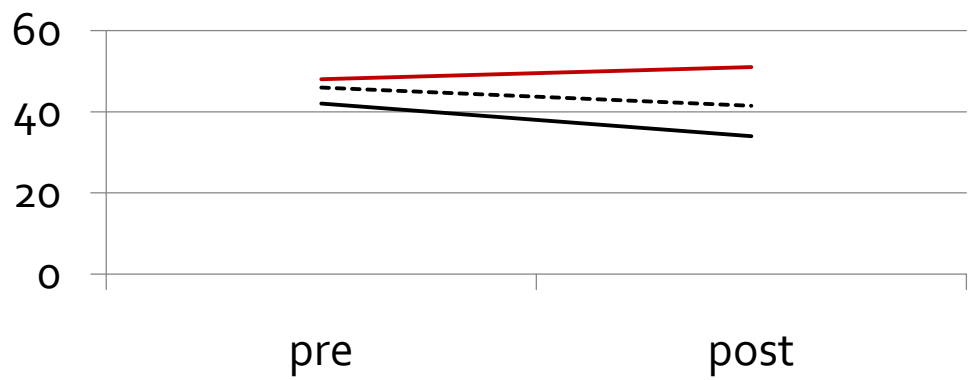
Burnout symptoms

Industrial health
2013; 51:336-346

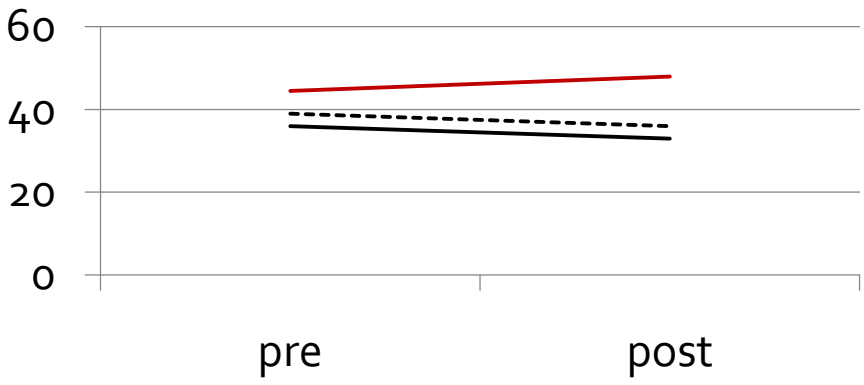
2 banks in taiwan
109 workers

30 min aerobic exercise
1x or 2x/week
12 weeks

control ----- low frequency —— high frequency



Personal burnout



Work-related burnout

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Exercise in the treatment of burnout

Gerber *et al. BMC Research Notes* 2013, **6**:78

12 men; 12 weeks; 17.5 kcal/kg/week

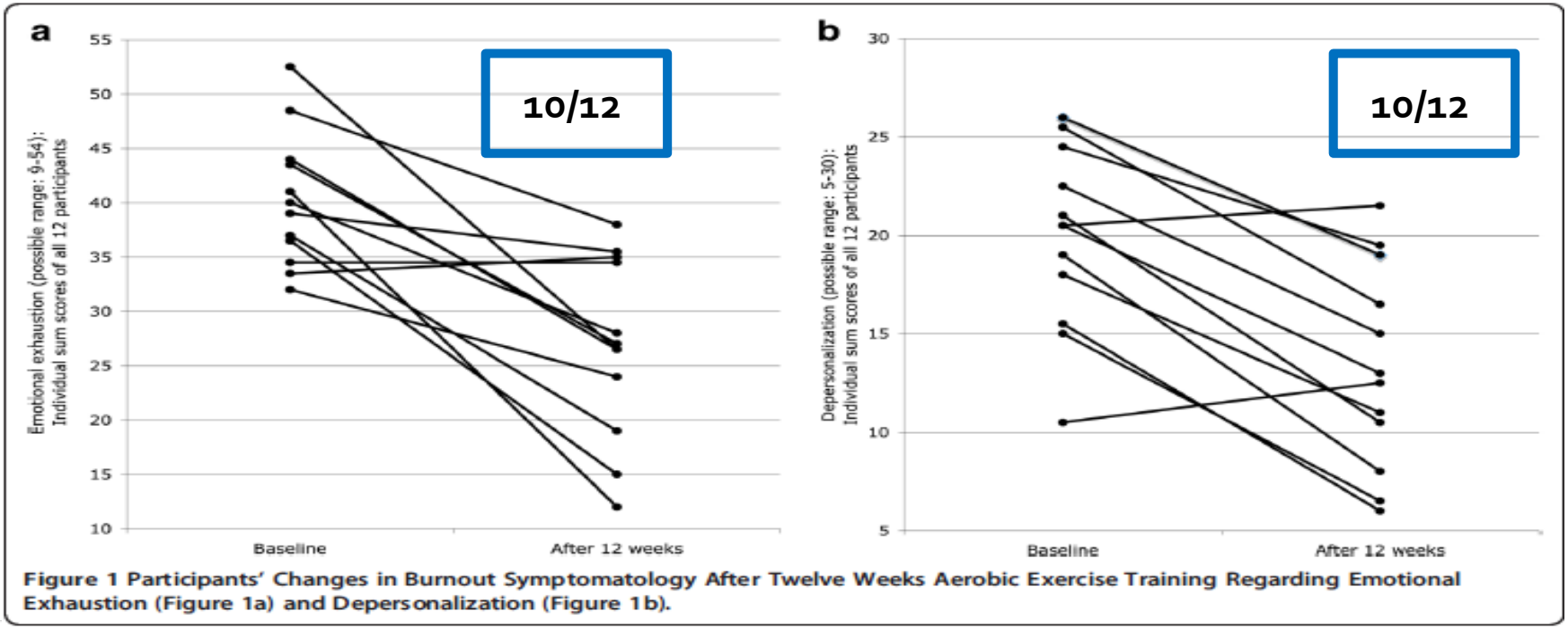

Figure 1 Participants' Changes in Burnout Symptomatology After Twelve Weeks Aerobic Exercise Training Regarding Emotional Exhaustion (Figure 1a) and Depersonalization (Figure 1b).

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Anxiolytic effects of exercise

Journal of Sport & Exercise Psychology, 2008, 30, 392-410

- Exercise vs. no treatment (3500 participants)

  ES=0.48

  ↓

  3,5 points on a scale that measures anxiety (range=60 p.)

NO CLEAR DOSE RESPONSE!

- Exercise vs. other treatments (2000 participants) →

Table 2 Effect Sizes of Types of Treatment Compared With Exercise

Treatment	*k*	Effect size
Cognitive/behavioral therapy	2	0.00
Group therapy	3	–0.09
Light exercise (stretching, yoga)	6	–0.15
Relaxation/meditation	9	–0.23
Stress management education	5	–0.45
Pharmacotherapy	2	0.11
Music therapy	1	–0.05
Total:	28	–0.19*

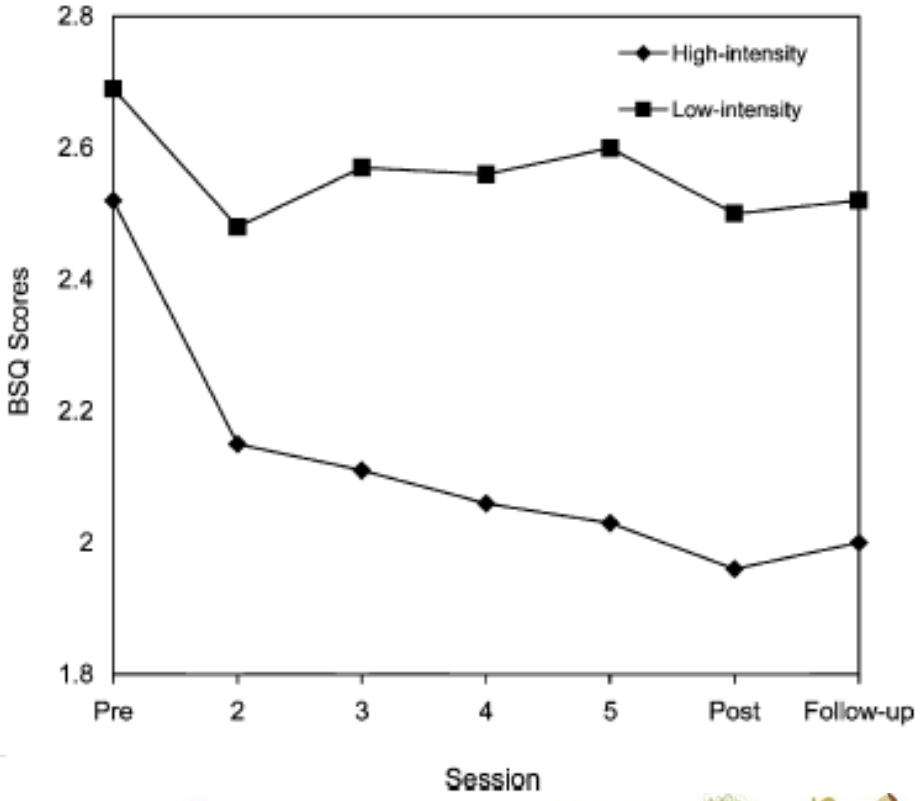
*One-sample *t* test, $p < .05$

Exercise and anxiety sensitivity

- 54 participants
- 6x20 min of aerobic exercise

- 20% and 50% of participants experienced a large decrease in ASI in moderate and vigorous exercise group, respectively

J.J. Broman-Fulks et al. / Behaviour Research and Therapy 42 (2004) 125–136



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Antidepressive effects of exercise

Sports Med 2009; 39 (6): 491-511

- 3000 participants
  ES=1.07
  ↓
  4 points on a scale that measures depression (range 63p.)

? Same as antidepressant medications

? Possibly better than psychotherapy

- In non-clinical population largest effects for:
  - medium-term interventions
  - short duration (20-30min)
  - combined aerobic and resistance exercise
  - High intensity (>75%)

NO CLEAR DOSE-RESPONSE!

Disturbed sleep and stress

- 558 women
- 20-60 years old
- Sweden

Daytime sleepiness (odds ratio)

Psychological distress	
None	1.0
Anxiety	2.43 (1.98-2.99)
Depression	3.99 (2.59-5.87)
Anxiety and depression	4.51 (3.51-5.79)

EPIDEMIOLOGY

What are the Important Risk Factors for Daytime Sleepiness and Fatigue in Women?

Jenny Theorell-Haglöw, BSc; Eva Lindberg, PhD; Christer Janson, PhD

SLEEP;29(6):751-757.

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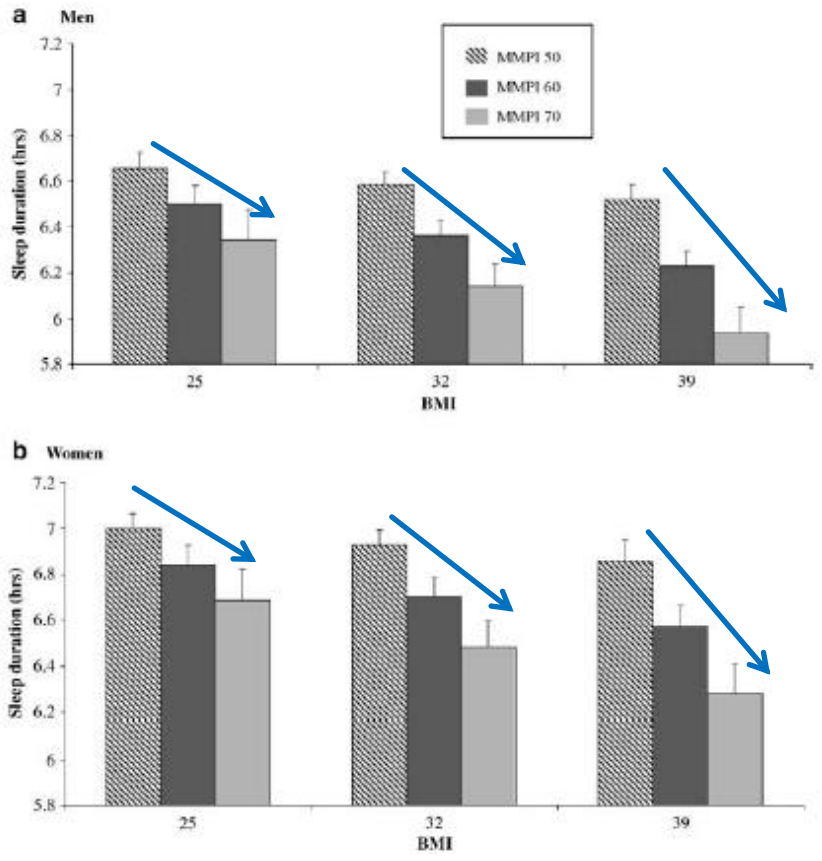
Disturbed sleep – effect of chronic stress on sleep duration

1300 middle aged men and women

Chronic emotional Stress

0.3-1h decrease in SD



Short sleep duration and obesity: the role of emotional stress and sleep disturbances

AN Vgontzas[1], H-M Lin[2], M Papaliaga[1], S Calhoun[1], A Vela-Bueno[3], GP Chrousos[4] and EO Bixler[1]

International Journal of Obesity (2008) **32**, 801–809;

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Is PA associated to sleep

- 65 years
- Prospective cohort study

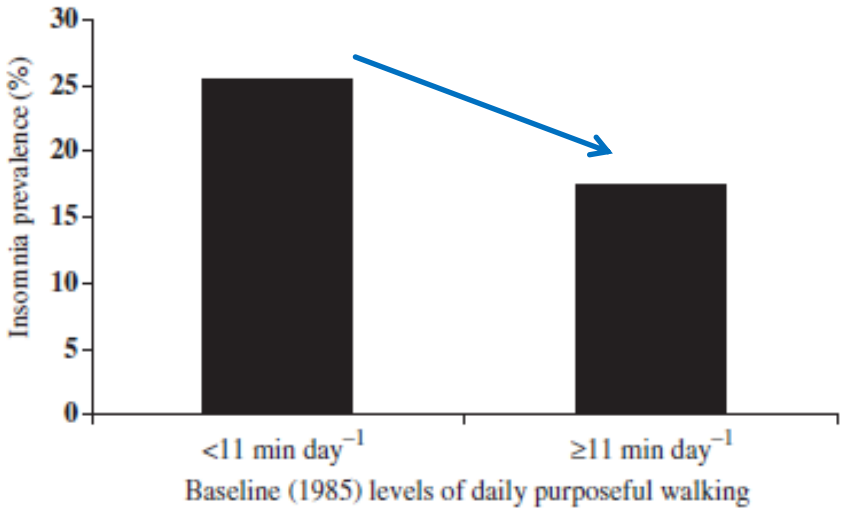


Figure 3. Prevalence of insomnia according to daily walking levels (categories = above/below median minutes/day purposeful walking; insomnia by walking level $\chi^2 = 8.72$; d.f. = 1; $P < 0.01$).

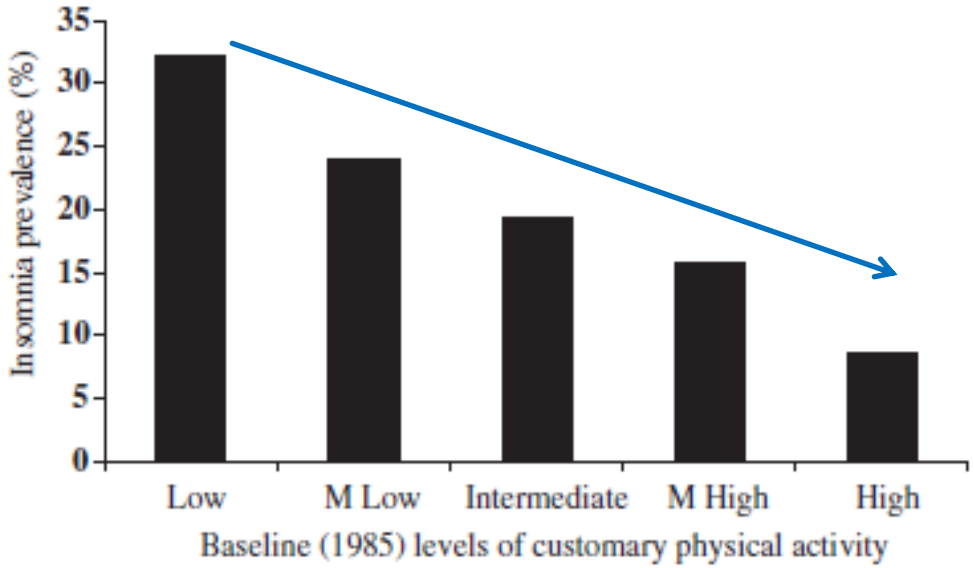
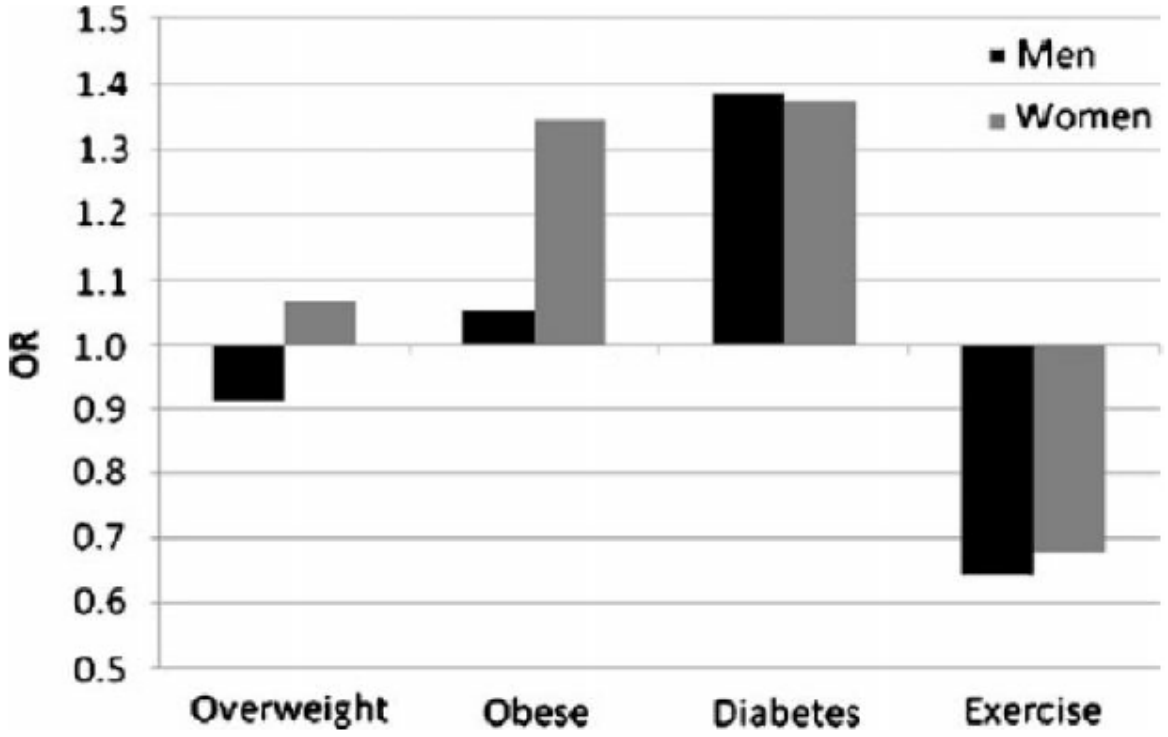


Figure 2. Prevalence of insomnia according to physical activity levels (categories = activity score quintile ranges; insomnia by physical activity $\chi^2 = 39.1$; d.f. = 1; $P < 0.001$).

Is PA associated to sleep

- 156 000 participants of the Behavioural Risk Factors Surveillance System

Sleep complaints



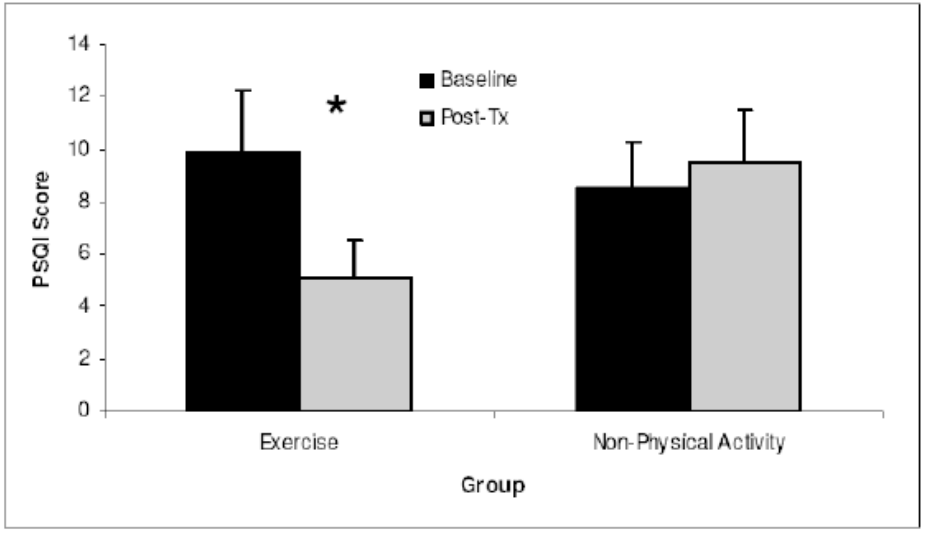
Can aerobic exercise training improve sleep?

Sleep Med. 2010 October ; 11(9): 934–940.

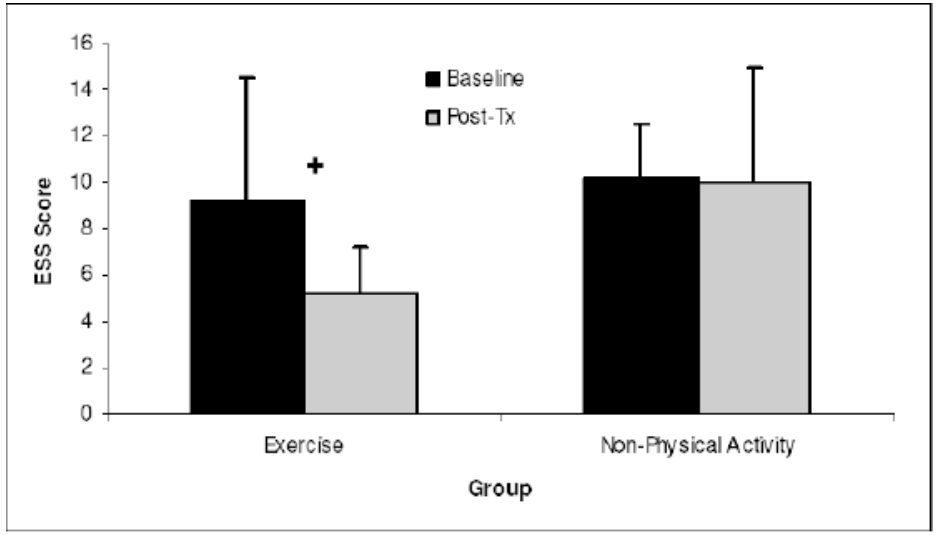
>55years
17 women
Insomniacs
sedentary

Exercise programme:
16 weeks
4 times/week
30-40 min
75%HR_{max}

Subjective sleep quality



Daytime sleepiness



Aerobic exercise training

G.S. Passos et al. / Sleep Medicine 12 (2011) 1018–1027

30-55 years
19 sedentary
Insomniacs
PSG:

Exercise programme:
6 months
3 times/week
50 min
VT1

Variable	Group	Pre-intervention	Post-intervention	Effect size Cohen's *d*
TST (min)	Morning	352.5 (17.6)	355.3 (11.0)	0.16
	Late afternoon	316. 5 (18.6)	351.5 (11.6)	1.71
	Combined	335.5 (13.1)	353.5 (7.7)	0.97
SOL (min)	Morning	16.8 (3.7)	10.5 (1.9)	−1.67
	Late afternoon	17.4 (4.4)	6.7 (1.8)	−2.46
	Combined	17.1 (2.6)	8.7 (1.4)	−2.06
LREM (min)	Morning	100.0 (15.8)	68.7 (5.8)	−2.23
	Late afternoon	122.4 (18.4)	72.8 (6.3)	−3.56
	Combined	110.6 (11.4)	70.6 (3.7)	−2.89
SE (%)	Morning	83.8 (4.1)	89.6 (2.1)	1.68
	Late afternoon	75.4 (4.9)	84.6 (2.7)	2.16
	Combined	79.8 (3.0)	87.2 (1.6)	1.91
WASO (min)	Morning	52.5 (17.7)	30.7 (7.8)	−1.45
	Late afternoon	75.2 (20.6)	50.5 (10.5)	−1.82
	Combined	63.2 (12.8)	40.1 (6.0)	−1.66

Stress related illnesses - CVD

Work stress and risk of cardiovascular mortality: prospective cohort study of industrial employees

Mika Kivimäki, Päivi Leino-Arjas, Ritva Luukkonen, Hilkka Riihimäki, Jussi Vahtera, Juhani Kirjonen

bmj.com 2002;325:857

- 812 employees, metal industry, Finland
  27-y follow-up

  - job strain
  - Effort-reward imbalance

↓

2-fold risk for CVD death

Table 2 Hazard ratios for cardiovascular mortality by levels of work characteristics. Adjusted for age and sex

Characteristic	No of participants (No of deaths)	Hazard ratio (95% CI)
Job strain:		
Low	215 (16)	1.00
Intermediate	389 (32)	1.53 (0.83 to 2.82)
High	201 (25)	2.20 (1.16 to 4.17)
Effort-reward imbalance:		
Low	269 (15)	1.00
Intermediate	272 (29)	2.21 (1.17 to 4.15)
High	271 (29)	2.36 (1.26 to 4.42)

PA and cardiovascular disease

Circulation 2011;124:789-795.

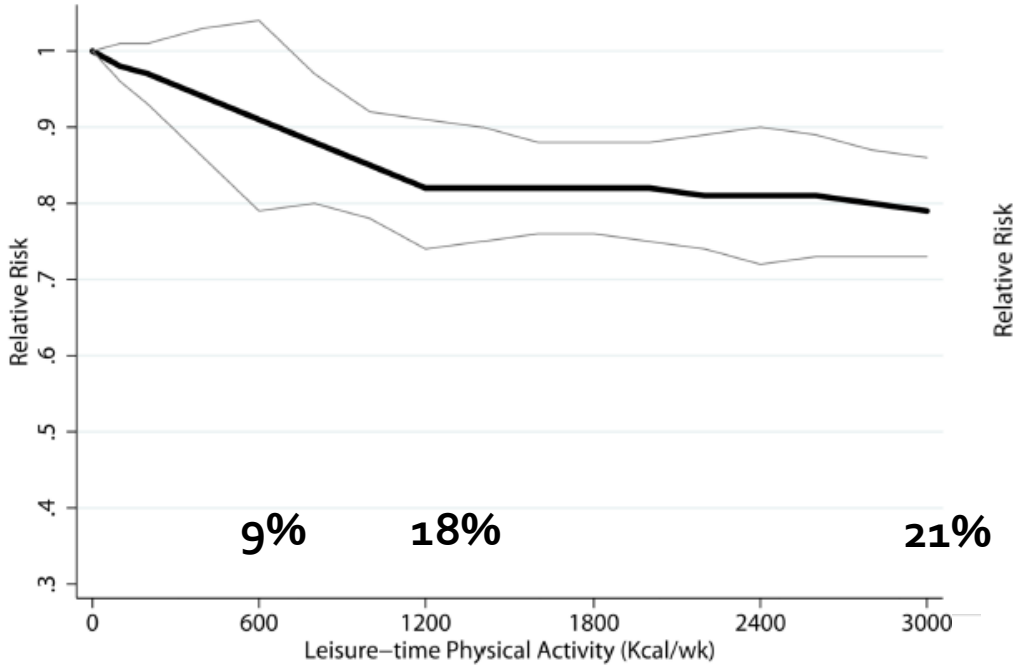
Most active vs. least active

	RR
Total PA	↓25%
Leisure time PA	↓26%
Work PA	↓16%
PA in transportation	↓13%

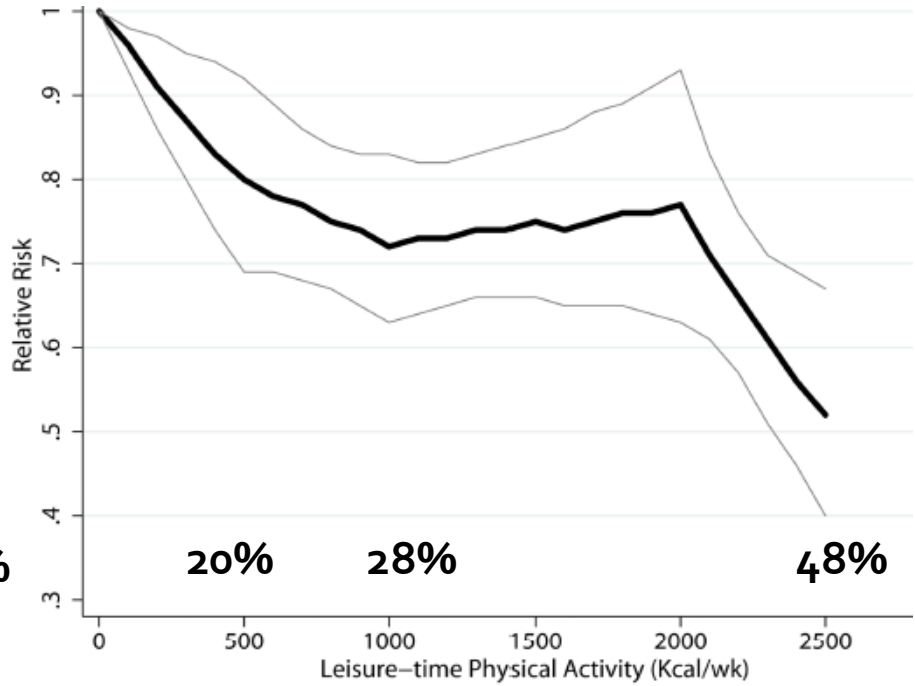
PA and CHD

Dose-Response Between Physical Activity and Risk of Coronary Heart Disease: A Meta-Analysis *Circulation*. 2011 August 16; 124(7): 789–795.

Men



Women



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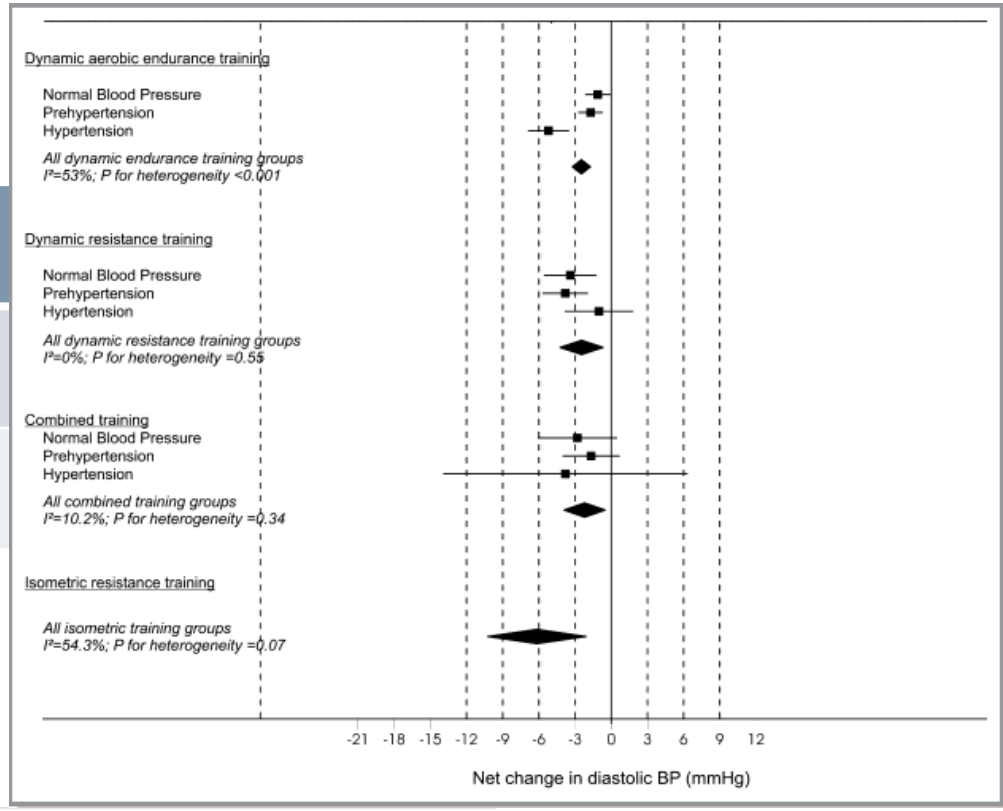
Stress related illnesses – PA and blood pressure

(J Am Heart Assoc. 2013;2:e004473

Type of training	Aerobic endurance	Dynamic resistance	Isometric resistance
RRsys	3.5mmHg	1.8mmHg	10.9mmHg
RRdy	2.5mmHg	3.2mmHg	6.2mmHg



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Employers corner
-the effects on absenteeism and productivity

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Stress and common cold

PSYCHOLOGICAL STRESS AND SUSCEPTIBILITY TO THE COMMON COLD

SHELDON COHEN, PH.D., DAVID A.J. TYRRELL, M.D., AND ANDREW P. SMITH, PH.D.

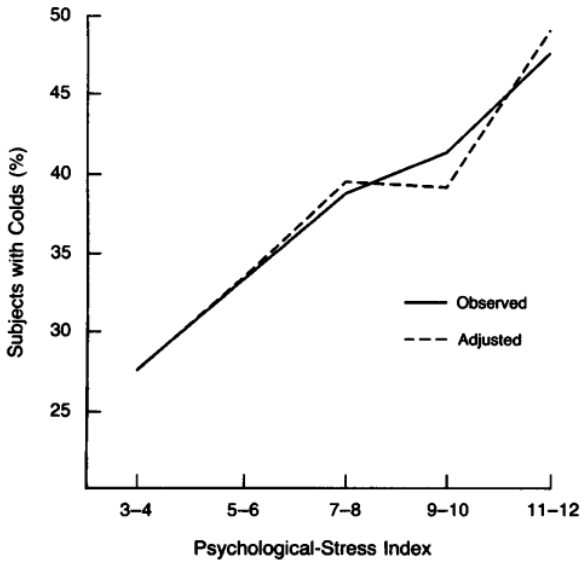
THE NEW ENGLAND JOURNAL OF MEDICINE 1991; 325:606-12.

- 420 participants
- Infected with a respiratory virus
- The lowest vs. the highest stress

↓

2 times increase in risk

Evidence for dose response →



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Common cold and production losses

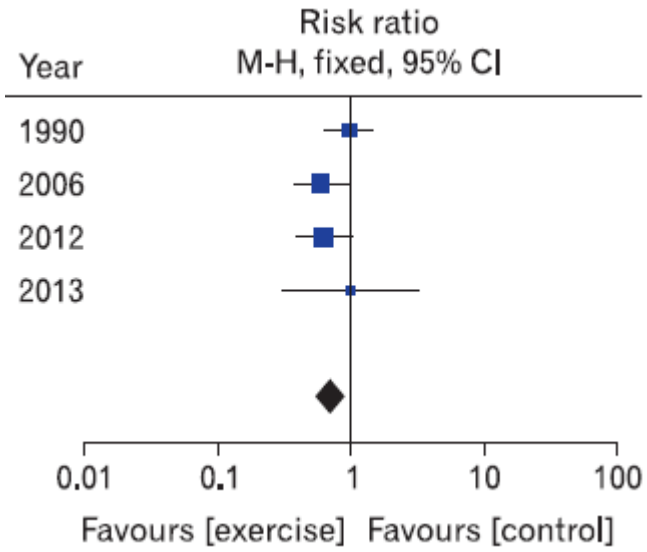
Allergy. 2010 Jun 1;65(6):776-83

- Sweden (+allergic rhinitis)
- 5 days/year
- 650€/worker/year
- 2,7 billions €

Exercise and common cold

Korean J Fam Med. 2014;35:119-126

- The impact of an exercise programme on common cold:
  - ↓27% risk
  - ↓3,5 days



Exercise and work ability

12-Mo Intervention of Physical Exercise Improved Work Ability, Especially in Subjects with Low Baseline Work Ability

Oili Kettunen [1,2,*], Timo Vuorimaa [3] and Tommi Vasankari [4,5]

Int. J. Environ. Res. Public Health **2014**, *11*, 3859-3869;

- 371 employees in Finland
- 12 months
- 3-5 x/week
- Moderate aerobic exercise

Measurement	Baseline	4-mo	8-mo	12-mo	24-mo	ANOVA during intervention 0–12-mo	ANCOVA during intervention 0–12-mo	ANOVA after follow-up 0–24-mo	ANCOVA after follow-up 0–24-mo
WAI									
exercise	41.4(4.7)	42.1(4.5) **	42.7(4.5) ***	42.8(4.6) ***	42.0(4.9)	$p = 0.002$	$p = 0.013$	$p = 0.011$	$p = 0.021$
control	42.5(4.9)	42.5(4.6)	42.5(5.1)	41.7(4.8)	40.7(5.3)				

2% 3% 3% 2%

Increases larger in those with worse baseline work ability!

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Exercise and productivity

Schwarz and Hasson
JOEM • Volume 53, Number 8, August 2011

- 200 participants, dental health centres, Sweden
- 2,5 h/week aerobic exercise or free activities
- Same workload

compared to reduced work hours and control:

- Increase in self-rated quantity of work and work ability
- Decrease in sickness frequency and duration
- No decrease in objective measures of productivity
- reduced costs in the exercise group (22.2%) and RWH (4.9%) conditions but not among controls (10.2% increase).

Implementation at the workplace

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Effect of the Work Environment on Using Time at Work to Exercise

Am J Health Promot. 2014 May 12. [Epub ahead of print]

- 188 faculty staff
  - Participants who felt comfortable taking time off work to exercise were 2.8 times more likely to use time to exercise
  - Participants who reported too much work were 3 times less likely to exercise
  - Job satisfaction and the ability to take time off for personal matters were not significantly associated

Is exercise a drug?

- Effect of withdrawal
  - 40 participants
  - At least 30 min, 3x/week, 6 months

Increase in:

- Fatigue
- Negative mood
- Depressive symptoms

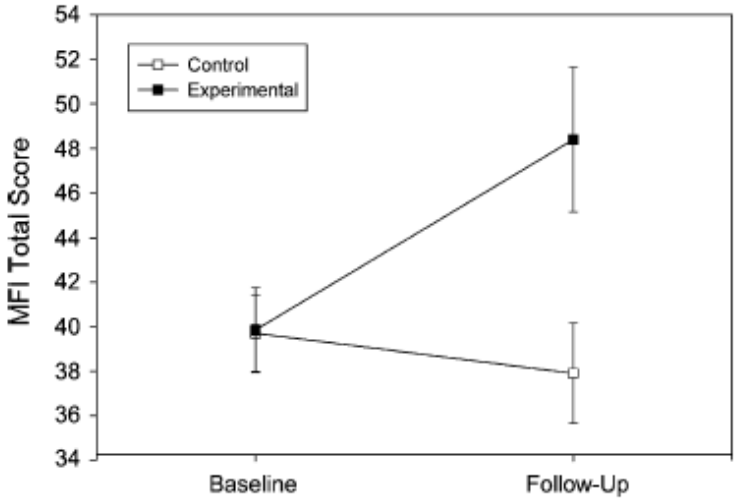

FIGURE 1—Increased MFI in exercise-withdrawal vs control participants. *Error bars* represent standard errors of the mean (SEM).

Implementation

- Min 20 min; 2-3x/week
- Aerobic or combined exercise
- No evidence for dose response for stress, but firm evidence regarding stress-related illness
- No loss of productivity;Dropouts mostly due to lack of time

Implemet exercise during work hours!

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Conclusions

- Are PA and stress associated? YES!
- Do PA and exercise improve one's ability to adapt to stress? YES!
- Can exercise programs reduce stress? YES!
- Can exercise programs reduce stress-induced medical problems? YES!

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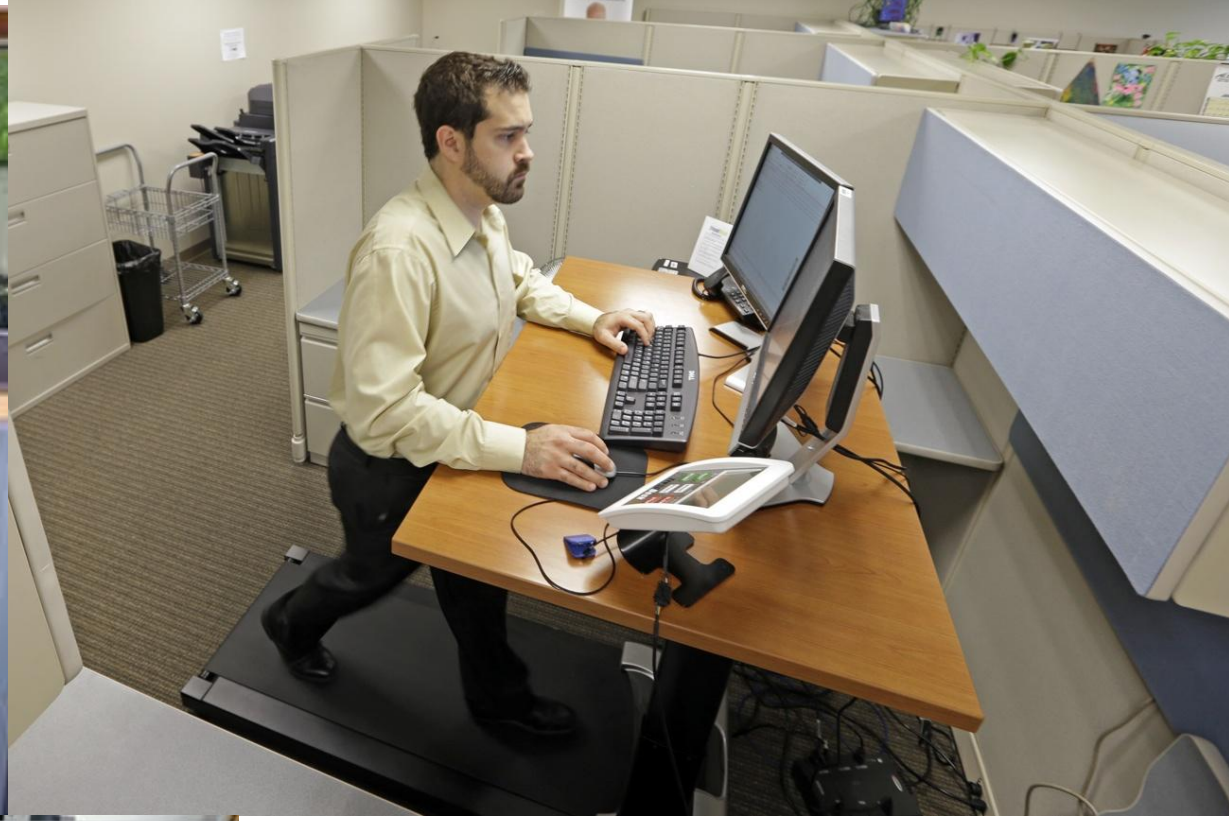
Good practice example

- CROZ (Zagreb, Croatia)
- Software industry
- 150 employers

Free bicycles for employers
To be used during work time



Direct your questions to: masoric@kif.hr

Pictures credits:

1. http://www.magnetrainer.com/ExerciseAtWork.php
2. http://www.columbian.com/news/2013/sep/16/more-americans-exercise-while-at-work/
3. http://1.bp.blogspot.com/-